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REPORT
GEOTECHNICAL STUDY
PROPOSED BRINE SHRIMP FACILITIES
OGDEN BAY WILDLIFE MANAGEMENT AREA
APPROXIMATELY 4600 SOUTH AND 7500 WEST
WEST OF HOOPER, UTAH

Submitted To:

JRCA Architects
577 South 200 East
Salt Lake City, Utah 84111

Submitted By:

AMEC Earth & Environmental, Inc.
Salt Lake City, Utah

July 3, 2002

Job No. 2-817-004015

July 3, 2002
Job No. 2-817-004015

JRCA Architects
577 South 200 East
Salt Lake City, Utah 84111

Attention: **Mr. Jim Child**

Gentlemen:

Re: Report
Geotechnical Study
Proposed Brine Shrimp Facilities
Ogden Bay Wildlife Management Area
Approximately 4600 South and 7500 West
West of Hooper, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Brine Shrimp Facilities located within the Ogden Bay Wildlife Management Area at approximately 4600 South and 7500 West, west of Hooper, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1991, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing existing facilities and the general location of the proposed structure is presented on Figure 2, Site Plan. The locations of the borings drilled in conjunction with this study are presented on Figure 2.

AMEC Earth & Environmental, Inc. (AMEC) also conducted a percolation test for the proposed septic tank/leach field system associated with the proposed facilities. The results of the percolation test are described in a summary letter dated July 3, 2002[1]. The location of the percolation test is also presented on Figure 2.

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[1] "Summary Letter, Field Percolation Test, Proposed Septic Tank/Leach Field System, Proposed Brine Shrimp Facilities, Ogden Bay Wildlife Management Area, Approximately 4600 South and 7500 West, West of Hooper, Utah," AMEC Job No. 2-817-004015.

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1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. Jim Child of JRCA Architects, and Mr. Bill Gordon of AMEC Earth & Environmental, Inc. (AMEC).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site.
2. Provide appropriate foundation, earthwork, and pavement recommendations to be utilized in the design and construction of the proposed structure.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the drilling, logging, and sampling of six exploration borings.
2. A laboratory testing program.
3. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided by an executed copy of our Proposal No. PL02-0423, dated April 16, 2002.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, AMEC must be informed so that our recommendations can be reviewed and amended, if necessary. This report is only for use in the design of the structures presented in the proposed construction section of this report. Any additional structures, additions, etc. are not covered in this report and AMEC must be contacted to evaluate the situation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices at this time.

2. PROPOSED CONSTRUCTION

The proposed brine shrimp facility is to be used for vehicle maintenance, office, and laboratory areas. The exact location of the building has not been finalized at the time of this report. The general site for the proposed structure is to the east of the existing structures at the Ogden Bay Refuge Headquarters. This area is currently an agricultural field surrounded by asphalt-paved roadways. The structure is proposed to be rectangular in shape and 5,000 to 6,000 square feet in area. The structure is anticipated to be one-extended level of light steel-frame and masonry block construction established slab-on-grade.

Structural loads will be transmitted down through columns and bearing walls to the supporting foundations. Maximum column and wall loads are anticipated to be on the order of 60 to 80 kips and 3 to 4 kips per lineal foot, respectively. It is projected that the floor slab loads will be light (less than 200 pounds per square foot).

Traffic in the parking areas will consist of a light volume of automobiles and light trucks, and occasional medium-weight trucks. In primary roadway areas, we project that the traffic will consist of a moderate volume of automobiles and light trucks, and a moderately light volume of medium-weight trucks and occasional heavy-weight trucks.

We anticipate that the proposed structure will be established at approximately one to two feet above existing grade. Maximum site grading cuts are anticipated to be minimal and fills will be on the order of two feet.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 6 exploration borings were drilled to depths ranging from 5.0 to 31.5 feet below existing grade. The borings were drilled using a truck-mounted rotary drill rig utilizing hollow-stem augers. Locations of the borings are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, relatively undisturbed samples of the typical soils penetrated were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications were later supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3F, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Unified Soil Classification System.

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Following completion of drilling operations, slotted PVC pipe was installed in Borings B-1 and B-2 in order to provide a means of monitoring the groundwater fluctuations.

3.2 LABORATORY TESTING

General

In order to provide data necessary for our engineering analyses, a laboratory testing program was initiated. The program included moisture, density, consolidation, pH, and soluble sulfates tests. The following paragraphs describe the tests and summarize the test data.

Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected undisturbed samples. The results of these tests are presented to the left on the boring logs, Figures 3A through 3F.

Consolidation Tests

To provide data necessary for our settlement analyses, a consolidation test was performed on each of two representative samples of the soils encountered in the exploration borings. The test results indicate that the fine-grained soils encountered at the site are highly over-consolidated and grade moderately over-consolidated with depth and will exhibit moderate strength and compressibility characteristics under the anticipated loading range. Detailed results are maintained within our files and can be transmitted to you at your request.

pH and Soluble Sulfates Tests

To determine if the site soils will react detrimentally with concrete, pH and soluble sulfates tests were performed on a representative sample of the natural near-surface soils. The results of these tests are presented below:

Boring No.	Depth (feet)	USCS Group Symbol	pH	Water Soluble Sulfate (ppm)
B-1	2.5	CL	8.8	27

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4. SITE CONDITIONS

4.1 SURFACE

The proposed site for the brine shrimp structure is located east of the existing headquarters buildings. The site is an agricultural field surrounded by asphalt-paved roadways. Beyond the roadways to the east, south, and north are open, undeveloped land. Farther to the south are residential homes. To the west of the site is the headquarters complex which consists of various shop buildings and three one- to two-level residential structures beyond. The residential and some of the shop structures are of wood-frame construction. The other shop buildings are of steel and concrete block construction. All of the structures are established slab-on-grade.

The site is relatively flat with overall relief of less than three feet across the site. Vegetation consists of tall grasses and weeds. The ground surface is highly disturbed from past agricultural activities.

4.2 SUBSURFACE SOIL

Subsurface conditions encountered at the boring locations were relatively consistent across the site. Borings B-1, B-2, and B-6 encountered one-half to one foot of non-engineered fills consisting of varying amounts of silt, sand, and gravel.

Beneath the fills and from the surface of the other borings are silts with varying amounts of clay and sand. These silts extend to depths of approximately 2.5 to 10.0 feet below grade, are slightly moist to saturated, medium stiff, brown to gray-brown, and except for the upper 12 to 18 inches will exhibit moderate strength and compressibility characteristics under the anticipated loading range. The upper 12 to 18 inches of the natural soils are loose due to normal weathering and past agricultural activity and will exhibit poor engineering characteristics. The loose fills will also exhibit poor engineering characteristics.

Underlying the silt soils are silty clays/clayey silts that grades to alternating layers to two inches thick of silty clay, clayey silt and fine sandy silt, and at depths of 13 to 18 feet to silty clays. The natural fine-grained soils are generally medium stiff to stiff; very moist to saturated; brown to gray; and will exhibit moderate strength and compressibility characteristics under the anticipated loading range.

The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In-situ, the transition between soil types may be gradual.

4.3 GROUNDWATER

On the day of the drilling and sampling operations, groundwater was measured in Borings B-1 and B-2 at depths of 4.0 and 4.7 feet below grade, respectively. Groundwater was likely encountered, but not measured in the other borings.

To facilitate monitoring future groundwater fluctuations, prior to backfilling Borings B-1 and B-2, slotted PVC pipe was installed. Boring B-6 was left open for one day to measure groundwater prior to backfilling. One day following drilling, groundwater was encountered at a depth of 4.7 feet in all three of these borings (B-1, B-2, and B-6).

Seasonal and longer-term groundwater fluctuations on the order of one foot should be anticipated. The highest seasonal levels will generally occur during the late spring and summer months.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The results of this study indicate that the site is suitable for the proposed structure. The primary geotechnical aspects of the site that will most influence the design and construction of the proposed facilities are the non-engineered fills and the upper 12 to 18 inches of natural soils which are "loose."

The results of our analysis indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. Under no circumstances should the building, rigid pavements, nor exterior flatwork be established over non-engineered fills, topsoil, the upper 12 inches of loose surficial soils, or other unsuitable soils. Flexible pavements may be placed over suitable natural soils; structural fill extending to suitable natural soils; properly prepared existing loose surficial soils; and/or properly prepared non-engineered fills that do not contain deleterious material or are more than one foot thick.

In the following sections, detailed discussions pertaining to earthwork, foundations, floor slabs, lateral resistance, pavements, and the geoseismic setting of the site are discussed.

5.2 EARTHWORK

5.2.1 Site Preparation

Preparation of the site must consist of the removal of all non-engineered fills, surface vegetation, topsoil, the upper 12 inches of loose surficial soils, and other deleterious materials from beneath an area extending at least three feet beyond the perimeter of the proposed building, rigid pavement, and exterior flatwork areas.

In flexible pavement areas, vegetation, topsoil, and other deleterious materials must be removed. Non-engineered fills and existing disturbed surficial soils may remain beneath flexible pavements as long as the exposed fill/soil is no more than two feet thick, is free of deleterious material, and is properly prepared. Proper preparation will consist of the scarification of the upper 9 to 12 inches, followed by moisture preparation, and recompaction to the requirements of structural fill. As an alternative, the upper 9 to 12 inches of fill and loose natural soils beneath the proposed pavement section can be removed, the exposed subgrade grade proofrolled, and 9 to 12 inches of structural fill placed. Non-engineered fills and existing disturbed soils prepared in this manner will have a reduced potential for excessive long-term settlement and differential settlement, but the potential will not be completely eliminated unless the non-engineered fills and disturbed soils are completely removed.

Subsequent to the above operations and prior to the placement of footings, structural site grading fill, floor slabs, or pavements, the exposed natural subgrade should be proofrolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least three times. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be totally removed. In pavement areas, unsuitable soils must be removed to a maximum depth of two feet and replaced with compacted granular structural fill. Unsuitable natural soils in floor slab areas must also be removed to a maximum depth of two feet.

5.2.2 Excavations

Excavations deeper than approximately four feet will likely encounter groundwater.

Temporary construction excavations not exceeding four feet in depth above or below the water table may be near vertical.

Deeper construction excavations up to eight feet in depth in natural cohesive soils above or below the water table may be constructed with sideslopes no steeper than one-half horizontal to one vertical. If excessive sloughing occurs, or if extensive layers of clean granular soils are encountered below the water table, the sideslopes should be flattened and may require dewatering and/or bracing. Excavations deeper than eight feet are not anticipated at the site.

All excavations must be inspected periodically by qualified personnel. If any signs of instability are noted, immediate remedial action must be initiated.

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5.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, and pavements. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and possibly as replacement fill. Structural site grading fill is defined as fill placed over relatively large open areas to raise the overall grade. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials.

Where stabilization of soft, saturated subgrade is required, a mixture of clean coarse gravels and cobbles or one and one-half to two-inch minus angular should be used.

For structural site grading fill, the maximum particle size should generally not exceed four inches. However, it should be noted that occasional larger particles, not exceeding eight inches in diameter, may be incorporated if placed randomly in a manner such that "honeycombing" does not occur and the desired degree of compaction can be achieved. The maximum particle size for structural fill placed within confined areas, such as footing and utility excavations, should generally not exceed two inches.

Existing suitable non-engineered fills and disturbed surficial soils may be utilized as structural site grading fill. Fine-grained soils will require close moisture control and may be very difficult, if not impossible, to properly place and compact during wet and cold periods of the year. In confined areas, we recommend that only granular soils be used. Generally, we recommend that all imported structural fill consist of a well-graded mixture of sands and gravels with no more than 18 percent fines (material passing the No. 200 sieve).

5.2.4 Fill Placement and Compaction

Coarse gravel and cobble mixtures, where utilized, should be end-dumped, spread to a maximum loose lift thickness of 9 to 12 inches, and compacted by dropping a backhoe bucket over the surface continuously at least twice. As an alternative, the fill may be compacted by passing a moderately heavy smooth-drum compactor over the surface at least twice. Subsequent fill materials placed over the gravels and cobbles must be placed so that the "fines" are "worked into" the voids in the underlying coarser gravels and cobbles.

All other structural fills should be placed in lifts not exceeding eight inches in loose lift thickness. Structural fill placed beneath footings or where the fill is 5 to 10 feet thick must be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[2] T-180 (ASTM[3] D-1557) compaction criteria. All other structural fill must be compacted to at least 90 percent of the above defined criteria.

American Association of State Highway and Transportation Officials
American Society for Testing and Materials

Prior to the placement of structural site grading fill, the subgrade should be prepared as discussed in Section 5.2.1, Site Preparation.

Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, pavements, etc.) should be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill should be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling may be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proofrolling, they should be removed to a maximum depth of two feet below design finish grade and replaced with structural fill.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

Design Data

The results of our analyses indicate that the proposed structures may be supported upon conventional spread and/or continuous wall foundations established within the upper four feet of suitable natural soils or structural fill extending to these soils. It is essential that the footings not be established overlying topsoil, non-engineered fills, loose/disturbed surficial soils, other loose or disturbed soils, or over improperly placed and compacted fill soils. A slightly higher bearing capacity may be used for footings established over a minimum of 12 inches of structural replacement fill extending to suitable natural soils. For design, the following parameters are recommended:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions for Footing Established Upon Suitable Natural Soils	- 2,000 pounds per square foot

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Recommended Net Bearing Pressure for Real Load Conditions for Footings Established Upon at Least 12 Inches of Structural Granular Fill Extending to Suitable Natural Soils	- 3,000 pounds per square foot
Bearing Pressure Increase for Uniform Seismic Loading (in clay soils)	- 50 percent

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

Natural soils below four feet exhibit low strength and high compressibility characteristics. If footings are to be established upon the deeper soils, AMEC must be notified.

5.3.2 Installation

Under no circumstances should the footings be installed over sod, rubbish, construction debris, topsoil, frozen soil, non-engineered fill, disturbed surficial soils, other deleterious materials, or within ponded water. If unsuitable soils are encountered, they must be totally removed and replaced with compacted granular structural fill.

The width of replacement fill below footings should be equal to the width of the footing plus one foot for each foot of fill thickness. For example, if the width of the footing is two feet and the thickness of the structural fill beneath the footing is one and one-half feet, the width of the structural fill at the base of the footing excavation would be a total of three and one-half feet.

5.3.3 Settlements

Settlement of foundations designed and installed in accordance with the above recommendations, and supporting maximum loads as discussed in Section 2., Proposed Construction, should not exceed one-half of an inch. Settlements will occur rapidly, with approximately 50 to 60 percent of the quoted settlements occurring during construction.

5.4 LATERAL RESISTANCE

Lateral loads imposed upon conventional spread and continuous wall foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction adjacent and between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of friction of 0.45 should be utilized for footings established on granular structural fill and 0.40 for natural soils. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.5 FLOOR SLABS

Floor slabs may be established upon suitable natural soils, a limited thickness of properly prepared loose surficial soils, and/or upon structural fill extending to these soils. Under no circumstances should floor slabs be established upon more than six inches of prepared loose surface soils, disturbed soils, sod, rubbish, construction debris, non-engineered fill, frozen soil, or other deleterious materials. In order to provide a capillary break and to facilitate curing of the concrete, it is recommended that floor slabs be directly underlain by at least four inches of "free-draining" fill, such as "pea" gravel or three-quarters to one-inch minus clean gap-graded gravel.

Settlement of lightly loaded floor slabs (less than 200 pounds per square foot) is anticipated to be less than one-quarter of an inch. <u>If heavier average floor loads are anticipated, we must be contacted</u>.

5.6 PAVEMENTS

The existing natural clayey soils encountered at the site will exhibit poor pavement support characteristics when saturated or near-saturated. Rigid pavements should only be placed over suitable natural soils or structural fill extending to these soils. Rigid pavements are not recommended over non-engineered fills or loose surficial soils, even if properly prepared. With these subgrade conditions and the projected traffic, the following pavement sections are recommended:

<u>Parking Areas</u>

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
and No Heavy-Weight Trucks)
[1 equivalent 18-kip axle load per day]

<u>Flexible:</u>

2.5 inches	Asphalt concrete
6.0 inches	Granular base
Over	Properly prepared non-engineered fills/natural soils and/or structural site grading fill

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<u>Rigid:</u>

5.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Base course (leveling fill)
	Properly prepared natural soils and/or structural site grading fill extending to these soils

<u>Primary Roadway Areas</u>

(Moderate Volume of Automobiles and Light Trucks,
Moderately Light Volume of Medium-Weight Trucks,
Occasional Heavy-Weight Trucks)
[5 equivalent 18-kip axle loading per day]

<u>Flexible:</u>

3.5 inches	Asphalt concrete
8.0 inches	Granular base
Over	Properly prepared non-engineered fills/natural soils and/or structural site grading fill

<u>Rigid:</u>

6.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Base course (leveling fill)
	Properly prepared natural soils and/or structural site grading fill extending to these soils

The above rigid pavement sections are for non-reinforced Portland cement concrete. Construction of the rigid pavement should be in sections 12 to 14 feet in width with construction or expansion joints or one-quarter depth saw-cuts on no more than 12-foot centers. Saw-cuts must be completed within 24 hours of the "initial set" of the concrete and should be performed under the direction of the concrete paving contractor.

The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent (±1 percent) air-entrainment.

As previously mentioned, flexible pavements placed over properly prepared non-engineered fills and disturbed surficial soils will have a potential for excessive long-term settlements and differential settlement, but the potential will not be completely eliminated unless the fills/soils are completely removed.

CEMENT TYPE

The chemical test results indicate that the natural site soils contain a negligible percentage of water soluble sulfates. Based upon this data, sulfate resistant cement will not be required for concrete in contact with the natural site soils.

5.8 GEOSEISMIC SETTING

General

In early 2002, Utah adopted the International Building Code (IBC) 2000. The IBC 2000 code determines the seismic hazard for a site based upon regional mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class (formerly soil profile type). The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). In comparison, the former UBC (Uniform Building Code) generally placed the entire Wasatch front into a single seismic zone (Seismic Zone 3).

The structures must be designed in accordance with the procedures presented in Chapter 16 of the International Building Code (IBC) 2000 edition.

Faulting

No active faults are known to cross the site, and the site is located away from fault investigation zones identified by Salt Lake County. The nearest active fault is the Wasatch Fault located approximately eleven miles east of the site. The Wasatch Fault is believed to be capable of producing earthquakes up to a magnitude 7.2.

Liquefaction

The site is located in an area that has been identified as having a "high liquefaction potential." Liquefaction is defined as the condition when saturated, loose, fine sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will not liquefy during a major seismic event.

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The soils encountered to the maximum depth penetrated are predominately clays which will not liquify, even during a major seismic event. Therefore, the probability of liquefaction induced damage is very low.

5.8.4 Site Class

For dynamic structural analysis, the Site Class "D" as defined in Table 1615.1.1, Site Class Definitions of the 2000 IBC, can be utilized.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

Michael S. Huber
Staff Engineer

Reviewed by:

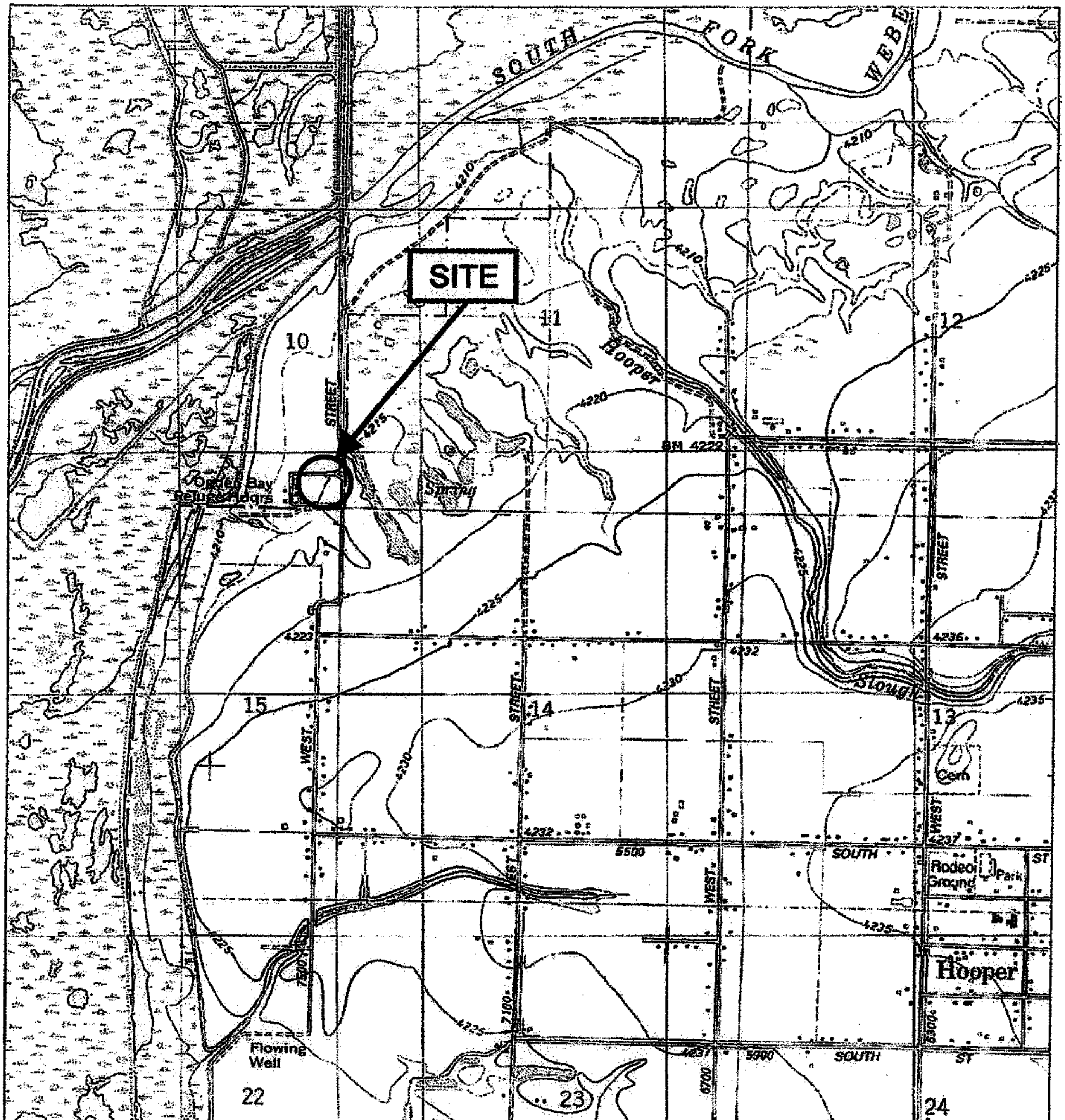
William J. Gordon, State of Utah No. 146417
Professional Engineer

MSH/WJG:sn

Encl.	Figure	1,	Vicinity Map
	Figure	2,	Site Plan
	Figures	3A	through 3F, Log of Borings
	Figure	4,	Unified Soil Classification System

Addressee (3)

JRCA ARCHITECTS
JOB NO. 2-817-004015



SCALE IN FEET
1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
TITLED "OGDEN BAY, UTAH"
DATED 1991

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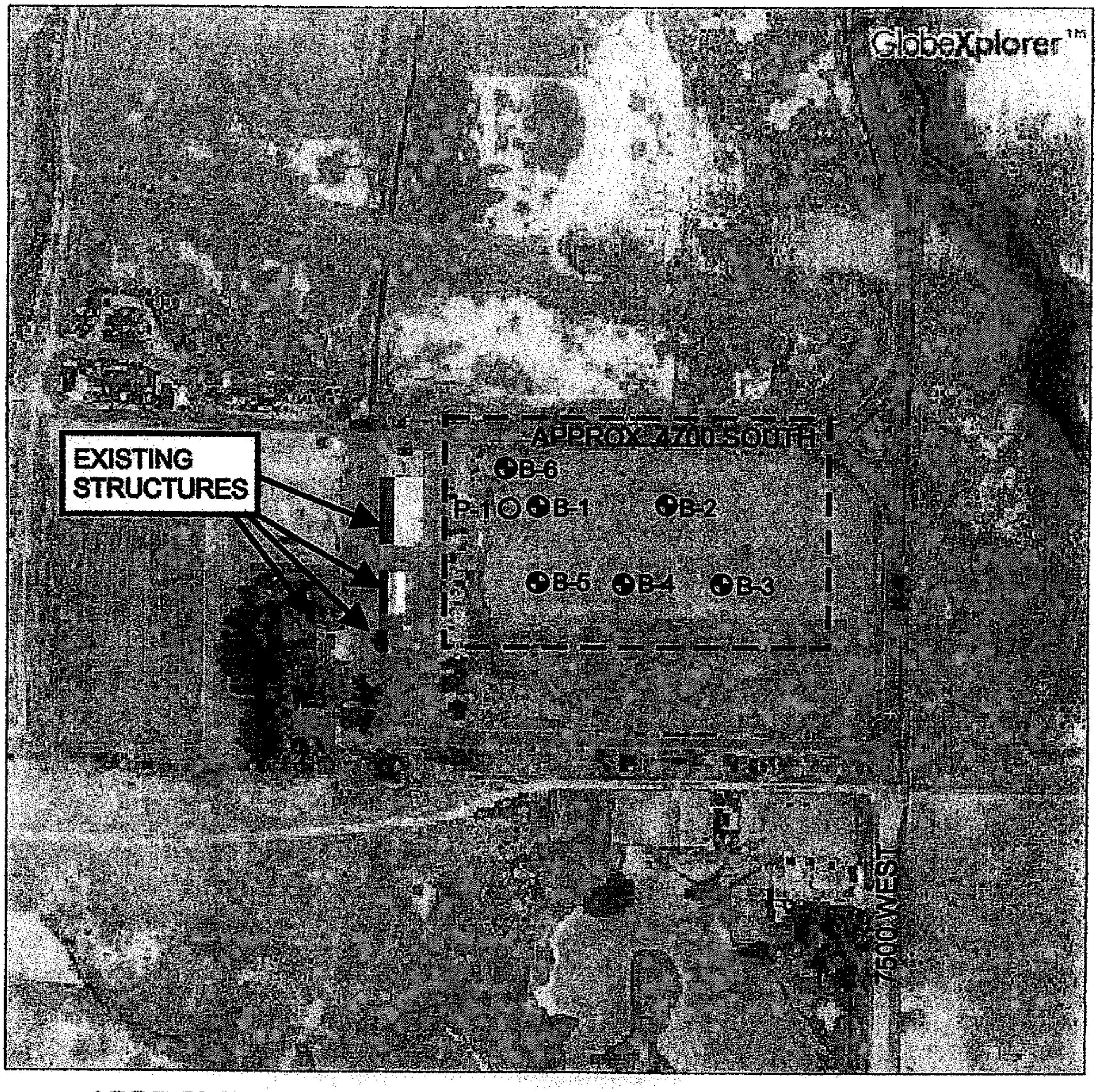
JRCA ARCHITECTS
JOB NO. 2-817-004015



- - - APPROXIMATE SITE
● APPROXIMATE BORING LOCATIONS
○ APPROXIMATE PERCOLATION TEST LOCATION

FIGURE 2
SITE PLAN

REFERENCE:
ADAPTED FROM AREAL PHOTOGRAPH,
GLOBXPLORER, EASTERN KODAK COMPANY
PROVIDED BY MAPQUEST.COM, DATED 2002

200 0 200 400
SCALE IN FEET

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PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah
JOB NO. 2-817-004015 DATE 06-12-02

LOG OF TEST BORING NO. B-1

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								GM FILL	dry loose	SILTY FINE TO COARSE SANDY FINE AND COARSE GRAVEL; brown; FILL
								ML	slightly moist to very moist upper 12" to 18" loose medium stiff	SILT with some clay and fine sand; gray-brown
			X	D	8					
								ML/ CL	very moist to saturated	SILTY CLAY/CLAYEY SILT with some fine sand; with numerous silty clay and clayey silt layers to 1"; gray and brown
5			X	D	8	94	27.3			
										grades to alternating layers to 2" of silty clay, clayey silt and fine sandy silt with numerous silty fine sand layers to 1/2"
10			X	D	7	82	30.1			
15			X	D	5	90	31.4			
								CL	saturated stiff	SILTY CLAY with trace fine sand; with occasional silt and fine sand layers 1" to 1-1/2" layers; gray
20			X	D	12					
25								CL/	saturated	ALTERNATING LAYERS TO 2"

GROUNDWATER

	DEPTH	HOUR	DATE
▽	4.0	16:00	06-12-02
▼	4.7	17:00	06-13-02

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3A

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PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah
JOB NO. 2-817-004015 DATE 06-12-02

LOG OF TEST BORING NO. B-1

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25			X	D	8			ML	medium stiff	OF SILTY CLAY AND CLAYEY SILT with numerous fine sandy silt and silty fine sand layers to 1/2"; brown to gray-brown
30			X	D	4			CL	saturated soft	SILTY CLAY with trace fine sand; gray to dark gray
35										Stopped drilling at 30.0'. Stopped sampling at 31.5'. Installed 1 1/4" diameter slotted PVC pipe to 18.0'.
40										
45										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
50										

GROUNDWATER

	DEPTH	HOUR	DATE
▽	4.0	16:00	06-12-02
▼	4.7	17:00	06-13-02

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3A
(con't)

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PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah
JOB NO. 2-817-004015 DATE 06-12-02

LOG OF TEST BORING NO. B-2

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	D	26			ML/FILL	loose	FINE AND COARSE GRAVELLY SILT with some fine to coarse sand; major roots (topsoil) to 5"; brown; FILL
								ML		
			X	D	6	91	31.3	ML/CL	slightly moist upper 12" to 18" loose medium stiff	SILT with some clay and fine sand; trace pinholes; brown
5									very moist to saturated medium stiff	SILTY CLAY/CLAYEY SILT with numerous clayey silt and silty clay layers to 1/2"; no pinholes; brown and gray
			X	D	12				stiff	grades with occasional fine sandy silt layers to 2"
			X	D	8	89	31.8		medium stiff	
10										
			X	D	7			CL	saturated medium stiff	SILTY CLAY with numerous clayey silt layers to 1" and occasional fine sandy silt layers to 1/4"; gray and brown
15										

Stopped drilling at 14.0'.

Stopped sampling at 15.5'.

Installed 1 1/4" diameter slotted PVC pipe to 10.0'.

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.

GROUNDWATER

	DEPTH	HOUR	DATE
▽	4.7	16:00	06-12-02
▼	4.7	17:00	06-13-02

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3B

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PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah

JOB NO. 2-817-004015 DATE 06-12-02

LOG OF TEST BORING NO. B-3

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	A				ML	slightly moist upper 12" to 18" loose	SILT with some fine sand; major roots (topsoil) to 2"; brown
			X	A					moist medium stiff	grades to clayey silt with some fine sand; brown
			X	A					very moist to saturated	
5										Stopped drilling at 5.0'. Groundwater likely encountered but not measured.
10										
15										
20										
25										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.

GROUNDWATER

	DEPTH	HOUR	DATE
∇			
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3C

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PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah

LOG OF TEST BORING NO. B-4

JOB NO. 2-817-004015 DATE 06-12-02

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A				ML	slightly moist upper 12" to 18" loose	SILT with some fine sand; major roots (topsoil) to 3"; brown
				A					moist medium stiff	grades to clayey silt with some fine sand; brown
5									very moist to saturated	
										Stopped drilling at 5.0'. Groundwater likely encountered but not measured.
10										
15										
20										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
25										

GROUNDWATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3D

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PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah

JOB NO. 2-817-004015 DATE 06-12-02

LOG OF TEST BORING NO. B-5

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				A				ML	slightly moist upper 12" to 18" loose moist medium stiff	SILT with some fine sand; major roots (topsoil) to 3"; some root/pinholes; brown
				A						grades to clayey silt with some fine sand; no pinholes; brown
				A						grades to fine sandy and clayey silt
5									very moist to saturated	
										Stopped drilling at 5.0'.
										Groundwater likely encountered but not measured.
10										
15										
20										
										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
25										

GROUNDWATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3E

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LOG OF TEST BORING NO. B-6

PROJECT Brine Shrimp Facilities
4600 South 7500 West, Hooper, Utah
JOB NO. 2-817-004015 DATE 06-12-02

RIG TYPE CME 550
BORING TYPE 4-1/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content of Percent Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								ML FILL	loose	FINE AND COARSE GRAVELLY SILT; major roots (topsoil) to 4"; brown; FILL
								ML	slightly moist upper 12" to 18" loose medium stiff	SILT with some fine sand; brown
5									very moist to saturated	grades to fine sandy and clayey silt
10										Stopped drilling at 10.0'.
15										
20										
25										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.

GROUNDWATER

	DEPTH	HOUR	DATE
▽			
▼	4.7	17:00	06-13-02

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3F

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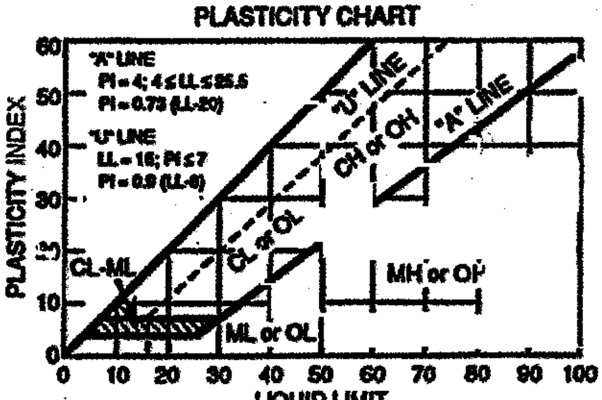
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified for engineering purposes by the Unified Soil Classification System. Grain-size analyses and Atterberg Limits tests often are performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. Graphic symbols are used on boring logs presented in this report. For a more detailed description of the system, see "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)" ASTM Designation: 2488-84 and "Standard Test Method for Classification of Soils for Engineering Purposes" ASTM Designation: 2487-85.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (... less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (50% ... coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands
					SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS Limits plot below "A" line & hatched zone on plasticity chart	SILTS OF LOW PLASTICITY (Liquid Limit less than 50)			ML	Inorganic silts, clayey silts of low to medium plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit 50 or more)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	CLAYS Limits plot above "A" line & hatched zone on plasticity chart	CLAYS OF LOW PLASTICITY (Liquid Limit less than 50)			CL	Inorganic clays of low to medium plasticity, gravelly, sandy, and silty clays
		CLAYS OF HIGH PLASTICITY (Liquid Limit 50 or more)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity
	ORGANIC SILTS AND CLAYS	ORGANIC SILTS AND CLAYS OF LOW PLASTICITY (Liquid Limit less than 50)			OL	Organic silts and clays of low to medium plasticity, sandy organic silts and clays
		ORGANIC SILTS AND CLAYS OF HIGH PLASTICITY (Liquid Limit 50 or more)			OH	Organic silts and clays of high plasticity, sandy organic silts and clays
ORGANIC SOILS		PRIMARILY ORGANIC MATTER (dark in color and organic odor)			PT	Peat

NOTE: Coarse-grained soils with between 5% and 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart have dual classifications.

PLASTICITY CHART



DEFINITION OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 12 in.
Cobbles	12 in. to 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 sieve
Sand	No. 4 to No. 200 sieve
Coarse sand	No. 4 to No. 10 sieve
Medium sand	No. 10 to No. 40 sieve
Fine sand	No. 40 to No. 200 sieve
Fines (silt and clay)	Less than No. 200 sieve

FIGURE 4

NOTES

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July 3, 2002
Job No. 2-817-004015

JRCA Architects
577 South 200 East
Salt Lake City, Utah 84111

Attention: **Mr. Jim Child**

Gentlemen:

Re: Summary Letter, Field Percolation Test
Proposed Septic Tank/Leach Field System
Proposed Brine Shrimp Facilities
Ogden Bay Wildlife Management Area
Approximately 4600 South and 7500 West
West of Hooper, Utah

1. INTRODUCTION

1.1 GENERAL

This letter summarizes the results of our field percolation test performed on June 13, 2001 on the Ogden Bay Wildlife Management Area located at approximately 4600 South and 7500 West, to the west of Hooper, Utah. A detailed layout of the site showing the lot boundaries as well as adjacent roads and lots is presented on Figure 1, Site Plan. A detailed layout of the site showing the location of the infiltration test (P-1) conducted for this study is presented on Figure 1.

AMEC Earth & Environmental, Inc. (AMEC) recently conducted a geotechnical study for the proposed facilities. The results of that study are described in a report dated July 3, 2002[1]. The location of the borings drilled in conjunction with our geotechnical study are also presented on Figure 1.

---

1 "Report, Geotechnical Study, Proposed Brine Shrimp Facilities, Ogden Bay Wildlife Management Area, Approximately 4600 South and 7500 West, West of Hooper, Utah," AMEC Job No. 2-817-004015.

AMEC Earth & Environmental, Inc.
4137 South 500 West
Salt Lake City, Utah 84123
Tel +1(801) 266-0720
Fax +1(801) 266-0727

OBJECTIVES AND SCOPE

The objectives and scope of our services were developed in discussions between Mr. Jim Child of JRCA Architects, and Mr. Bill Gordon of AMEC Earth & Environmental, Inc. (AMEC).

The objectives of our services were to:

1 Define the subsurface soil and groundwater conditions at the proposed leach field area.

2. Determine the percolation rate of the soils below the base elevation of the proposed leach system.

In accomplishing the above objectives, our scope included the following:

1 A field program consisting of the drilling, logging, and sampling of six exploration borings.

2. The performance of a field percolation test.

3. The preparation of this summary letter.

AUTHORIZATION

Authorization was provided by an executed copy of our Proposal No. PL02-0423, dated April 16, 2002.

2. PROPOSED CONSTRUCTION

The proposed brine shrimp facility is to contain vehicle maintenance, office, and laboratory areas. The exact location of the building has not been finalized at the time of this report. The general site for the proposed structure is to the east of the existing structures at the Ogden Bay Refuge Headquarters. This area is currently an agricultural field surrounded by asphalt-paved roadways. The structure is proposed to be rectangular in shape and 5,000 to 6,000 square feet in area. We anticipate that the structure will have at least one restroom facility and various utility sinks.

As part of site development, a septic tank/leach field system will be installed down-gradient from the home. The location of the percolation test was selected on-site in the likely area of the leach field.

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3. SITE CONDITIONS

3.1 SURFACE

The proposed site for the brine shrimp structure is located on the Ogden Bay Wildlife Management area and is to the east of the existing headquarters buildings. The site is an agricultural field surrounded by asphalt-paved roadways. Beyond the roadway to the east, south, and north is open, undeveloped land. Farther to the south are residential homes. To the west of the site are the headquarter buildings which consist of various shop buildings with three one- to two-level residential structures beyond. The residential and some of the shop structures are of wood-frame construction. The other shop buildings are of steel and concrete block construction. All of the structures are established slab-on-grade. The existing on-site septic systems are located to the west of the proposed site between the shops and home and beyond the homes.

The site is relatively flat with overall relief of less than three feet across the site. Vegetation consists of tall grasses and weeds. The ground surface is highly disturbed from past agricultural activities.

3.2 SOIL CONDITIONS

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 6 exploration borings were drilled to depths ranging from 5.0 to 31.5 feet below existing grade. The borings were drilled using a truck-mounted rotary drill rig utilizing hollow-stem augers. Locations of the borings are presented on Figure 2. The soil conditions encountered in all six borings were quite similar. Boring B-1 is located near where the percolation test was performed.

Boring B-1 encountered six inches to one foot of gravelly loamy sand on the surface underlain by silt loam to a depth of four feet. Beneath the silt loams to a depth of 18.5 feet is loam which grades to alternating layers up to two inches thick of loam, silt loam, sandy loam, silty clay loam, and clay loam. Underlying these soils are mainly clay loam soils with varying frequencies of thin sand and sandy loam layers. The soils encountered are slightly moist and grade saturated with depth; brown to gray; and loose near the surface and medium stiff to stiff below.

Logs of the subsurface conditions encountered in Boring B-1 are presented on the attached "Percolation Test Certificate and Soil Exploration Results." Soils have been classified in accordance with the USDA Classification System.

3.3 GROUNDWATER CONDITIONS

On the day of the drilling and sampling operations, groundwater was measured in Borings B-1 and B-2 at depths of 4.0 and 4.7 feet below grade, respectively. Groundwater was likely encountered, but not measured in the other borings.

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To facilitate monitoring future groundwater fluctuations, prior to backfilling Borings B-1 and B-2, slotted PVC pipe was installed. Boring B-6 was left open for one day to measure groundwater prior to backfilling. One day following drilling, groundwater was encountered at a depth of 4.7 feet in all three of these borings (B-1, B-2, and B-6). These measurements correspond to those of reported levels in the area.

The groundwater measurements were taken near seasonal highs. Seasonal and longer-term groundwater fluctuations on the order of six inches to one foot should be anticipated. Existing systems at the headquarters have only encountered groundwater problems when the Great Salt Lake flooded years ago. The highest seasonal levels will generally occur during the late spring and summer months.

4. FIELD PERCOLATION TESTS

PROCEDURE

A field percolation test (P-1) was performed: 1) in accordance with the Utah Department of Environmental Quality (UDEQ) regulations for "Onsite Wastewater Systems," August 28, 2001; and 2) at depths of two feet below existing grade in the area of Boring B-1. The proposed septic tank/leach field system must be designed in accordance with the UDEQ August 28, 2001 (or more recent) criteria.

The depth of the percolation test was chosen to represent the soil layer beneath the base of the proposed system.

TEST DATA

Results of the test are summarized on the attached Utah State Department of Health's "Percolation Test Certificate and Soil Exploration Results" forms. The percolation test (P-1) had an acceptable percolation rate.

5. CONCLUSIONS AND RECOMMENDATIONS

The measured percolation rate was 36.92 minutes per inch at the location of P-1. The results of this study indicate that the silty loam soils tested in the vicinity of Boring B-1 are sufficiently permeable for a leach field system. Due to the similar soil conditions encountered at the other boring locations, the percolation rates across the site for the silty loam soils are anticipated to be similar to those measured. For design, we recommend a rate of 40 minutes per inch be used. The proposed septic tank/leach field system must be set back from existing and proposed features in accordance with the Utah Department of Environmental Quality, regulations for "Onsite Wastewater Systems," August 28, 2001 (or more recent).

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We appreciate the opportunity of performing this service for you. If you have any questions, please do not hesitate to call us.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

Michael S. Huber
Staff Engineer

Reviewed by:

William J. Gordon, State of Utah No. 146417
Professional Engineer

MSH/WJG:sn

Figure 1, Site Plan
Percolation Test Certificate and Soil Exploration Results

Addressee (3)

JRCA ARCHITECTS
JOB NO. 2-817-004015

- - - APPROXIMATE SITE
● APPROXIMATE BORING LOCATIONS
○ APPROXIMATE PERCOLATION TEST LOCATION

FIGURE 1
SITE PLAN

REFERENCE:
ADAPTED FROM AREAL PHOTOGRAPH,
GLOBXPLORER, EASTERN KODAK COMPANY
PROVIDED BY MAPQUEST.COM, DATED 2002

200 0 200 400
SCALE IN FEET

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PERCOLATION TEST CERTIFICATE AND SOIL EXPLORATION RESULTS
Information Required for Determining Soil Suitability for Individual Wastewater Disposal Systems

Name: Proposed Brine Shrimp Facilities

Location of Property: Ogden Bay Wildlife Management Area
Approximately 4600 South and 7500 West
West of Hooper, Utah

I certify that percolation tests have been conducted on the above property, in accordance with requirements specified in R317-511, Utah Administrative Code, and that percolation rates, calculated as specified by said rule, are as follows (use reverse side or additional sheets if necessary):

Test Hole Number	Test Hole Depth	Saturation Period (hrs & min)	Swelling Period (hrs & min)	Inches Drop Final 30 min. Period*	Final Stabilized Percolation Rate** (min/inch)
P-1	2.0 ft	4 hrs	20 hrs 15 min	13/16 in	36.92

Statement of soil conditions obtained from soil explorations to a depth of 10 feet. In the event that absorption systems will be deeper than 6 feet, soil explorations must extend to a depth of at least 4 feet below the bottom of the proposed absorption field, seepage trench, seepage pit, or absorption bed. A descriptive log of each exploration hole should be given:

B-1:	0.0 to (0.5 to 1.0) feet	Gravelly Loamy Sand; topsoil and major roots to 3"; brown, FILL
	(0.5 to 1.0) to 4.0 feet	Silty Loam; gray-brown
	4.0 to 18.5 feet	Loam grades to alternating layers to two inches of loam, silty loam, sandy loam, silty clayey loam and clayey loam; gray and brown
	18.5 to 31.5 feet	Clayey Loam with varying frequencies of thin sand and sandy loam layers; brown, gray-brown and gray

Date soil exploration(s) conducted: June 12, 2002

Statement of present and maximum anticipated groundwater table throughout the property and area of the proposed soil absorption system: Stabilized at 4.7 feet below existing grade

Date groundwater table determined: June 13, 2002

I hereby certify to the best of my knowledge, the foregoing information is correct.

Name: Michael S. Huber
Staff Geotechnical Engineer

Address: AMEC Earth & Environmental, Inc.
4137 South 500 West
Salt Lake City, Utah 84123

Signed: [signature] Date July 3, 2002
(unsigned test certificates will not be accepted)

Ten-minute time intervals between percolation test measurements may be used only for certain circumstances -- refer to detailed instructions for conducting percolation tests referenced above. If a 10-minute interval is used for tests, so indicate.
Percolation rate is equal to period of time used in minutes, divided by distance water dropped in inches and fractions thereof.